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VEGETABLE PHYSIOLOGY.[1]

Woronin on Sclerotinia.—Dr. Woronin who was formerly associated with De Bary and whose beautiful studies of the life history of the smut fungus, *Tuburcinia trientalis* at once placed him among the very foremost investigators in a difficult field, continues to unravel interesting life histories of the pleomorphic fungi. Some years ago he published valuable researches on the Sclerotinia diseases of Vaccinium berries, and now distributes an important paper on the Sclerotinia disease of the bird cherry and of mountain ash. This paper (Die Sclerotinienkrankheit der gemeinen Traubenkirsche und der Eberesche, *Sclerotinia padi* und *Sclerotinia aucupariae*) is a quarto of 27 pages illustrated by five superb lithographic plates. It is printed in *Mém. de l'Acad. imp. de St. Petersbourg,* VIII, sé., Class Physico-Mathematique, Vol. II, No. 1. *S. padi* attacks and kills young leaves, fruit and stems of *Prunus padus,* on which the grayish, pulverulent conidia soon appear. On the host plant these conidia cause a distinct almond-like odor similar to that of the flowers, but no such odor could be detected when the fungus was grown on artificial media. Growing on the mountain ash the conidia of *S. aucupariae* cause an odor resembling that of the flowers of that tree. The apothecia of *S. padi* appear in the spring on the fallen, mummified fruits. Paraphyses and asci are always borne by distinct hyphae, the ascogeneous hyphae being stronger and thicker. The ascospores have two envelopes, an outer delicate one which is cast off in water and subsequently becomes gelatinous to complete disappearance, and an inner, colorless, thick-walled true membrane. When germinated in pure water the ascospores soon begin to form chains of small round spermatia-like sporidia, and the conidia behave in the same way. Ascospores sown in nutrient media or on the host send out strong germ tubes, but conidia or ascospores taken from nutrient media and put into pure water stop the production of hyphae and begin to form the above mentioned sporidia. In nutrient media an abundant conidial fructification was developed from ascospores in 3–4 days, and this was exactly like that observed in nature. Direct experiment with ascospores showed that the leaves are infected as they emerge from the bud, the stems being browned and killed by a secondary infection, just as peach twigs are destroyed by Monilia fructigena, only in case of the peach the stem infection takes place apparently only through the blossoms or fruits, and here apparently only through the leaves. The striking similarity may be seen by comparing Woronin's Fig. 23, Table II, with *Journal of Mycology,* Vol. VII, Plate V, figs. 1, 2 and 3. The germ tubes bore directly through the epidermal cells of the host or penetrate at the junction of two or more cells. In no case were they found entering through stomata, although most of the infections were through the underside of the leaf. On culture media long chains of conidia develop before any septa appear. Finally the ripe conidia are separated by delicate spindle-form or diamond-shaped disjunctors consisting of two minute cones of cellulose joined at their bases and having their apices connected with the two adjacent spores. Neighboring ascospores and conidia as well as germ tubes often fuse, and this is very striking in case of the infection of the incipient fruit through the stigma. For this purpose a half dozen conidia may fuse into a sort of colony or association giving rise to a single, very robust hypha which grows down the style after the manner of a pollen tube and finally infects the ovary. Fusions of spores and of hyphae are common enough in fungi, but fusion for so manifest and important an end is certainly noteworthy. The elongated penetrating hypha usually remains unbranched until the ovary is reached. In 3–4 days from the time of placing the spores on the stigma the germ tube has reached and entered the micropyle, and a day or two later the nucellus is invaded. No further development of the fungus takes place unless the flower has been fertilized by a pollen tube. In that case there is a movement of nutrient substances into the ovary, and on these the fungus makes a luxuriant growth. First the nucellus is occupied, then the integuments are invaded, and finally the pericarp, following which the young fruit browns externally and shrivels, and, if the air is moist enough, conidia appear on its surface. During early stages of germination 4–10 problematic bodies resembling nuclei appeared pretty constantly in each germ tube and then disappeared. The fungus on mountain ash is smaller than *S. padi,* but is otherwise very similar. The paper closes with 5 pages on relationships among Sclerotinia.—ERWIN F. SMITH.

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[1] This department is edited by Erwin F. Smith, Department of Agriculture, Washington, D. C.

Demonstration of Photosyntax by Bacteria.—In *Verhandelingen d. Koninklijke Akad. van Wetenschappen te Amsterdam* (2 Sectie, Deel III, No. 11) Professor Th. W. Engelmann summarizes in a brief paper (Die Erscheinungsweise der Sauerstoffausscheidung chromophyllhaltiger Zellen im Licht bei Anwendung der Bacterienmethode) what is known on this subject, and illustrates it very satisfactorily by a well executed chromolithographic table. The value of this method rests on the fact that aerobic motile bacteria cease to move as soon as oxygen is withdrawn, and again become motile when a trace of it is added. This method of showing the photosyntax of chlorophyll-bearing cells is very delicate and exceedingly simple. A round green algal spore is placed on a slide in the center of a drop of water containing some aerobic actively motile bacterium and imprisoned by an ordinary cover glass cemented to the slide air tight by vaseline. If this preparation is now examined immediately, the bacteria will be found uniformly distributed through the drop and actively motile. They pay no attention to the green spore because they find sufficient oxygen everywhere. If the slide is now placed in the dark the movement of the bacteria gradually ceases with the exhaustion of the oxygen, and in this condition also the bacteria pay no attention to the algal cell. If, however, such a slide be left exposed to the light, the bacteria begin in a minute or two to swarm around the green spore and continue to do so as long as it is exposed to the light. Under these conditions there is a zone close to the spore and about as wide as the diameter of the latter, crowded with actively motile bacteria, a much wider zone in which there are only a few organisms swimming about, and a remoter zone of uniformly distributed non-motile bacteria. If now the mirror of the microscope be shaded so as to let barely enough light through for seeing, all self motion ceases and the bacteria which have crowded into a narrrow zone around the green spore begin to be distributed through the liquid uniformly by molecular movements. When bright light is flashed in again, active movement begins immediately, centering around the spore, and the two zones are reproduced, but if only a moderate amount of light is let in, only a small amount of oxygen is given off, only a few bacteria become motile, and these crowd back the rest forming a narrow clear zone of motile organisms, bounded by a crowded quiet zone, bounded in turn by a clear quiet zone, outside of which the bacteria are evenly divided. If a little more light be let in the number of motile organisms around the green spore increases, the inner clear zone widens, and finally with full light we have immediately the first condition, viz., a dense swarming mass of organisms around the algal cell, next a wide zone having in it only occasional rods, all of which are motile, and farther away a uniform distribution of organisms, which are non-motile because they have not felt the influence of the oxygen given off by the green spore. The algal cell of course gets from the bacteria CO_2 in return for the oxygen. Beautiful results can be obtained with threads of Cladophora, Spirogyra and other algæ, and

Spirogyra with the hay bacillus may be used to show that it is not the colorless protoplasm, nucleus, cell sap, or cell wall, but only the chromophyll bodies that give off oxygen. Light thrown on a chlorophyll band of Spirogyra causes the bacteria to swarm to it, while light thrown on any other part of the cell causes no crowding or movement of the bacteria. Light thrown on a chlorophyll band, after being passed through an alcoholic solution of chlorophyll derived from Spirogyra, caused no crowding or movement of the bacteria, while light passed through red glass, although less intense, caused an active swarming of the bacteria around the illuminated part of the band. The same method may be used to show whether red and variously colored cells contain chlorophyll, and whether the chlorophyll-bearing protoplasm of a cell is living or dead. The author obtained some of his results with undetermined bacteria from the surface of slightly foul water, but fresh cultures of Bacillus subtilis also gave good results. Organisms which make only a small demand on free oxygen, such as Vibrio lineola and Spirillum tenue give somewhat different results. In this case the motile organisms crowd around the algal spore or thread only when it is under the influence of feeble light. When bright light is let in, too much oxygen is given off, and a space is cleared around the green cell which widens or narrows in proportion to the varying of the light. With waning vigor of the chlorophyll the same results are obtained in bright light as with vigorous cells in feeble light, i. e., a crowding of the bacteria close up to the algal cell. The appended bibliography includes 61 titles, beginning with the year 1881, when Engelmann first published on this subject.—ERWIN F. SMITH.

Detection of Glukase by Auxanographic Methods.—Beyerinck has devised a neat method for showing that the enzym, glukase, first changes cooked starch into dextrine and subsequently into glucose. Over ½ the bottom of a Petri dish or similar receptacle, which part we will designate A, he pours a nutrient gelatine (10 per cent. gelatine; ½ per cent. soluble starch; ¼ per cent. asparagin; $\frac{1}{20}$ per cent. potassium phosphate) infected with Saccharomyces ellipsoideus or any other maltose yeast which is able to take nitrogen from asparagin, but will not react on dextrine. Into the other ½ of the dish, which we will designate B, he pours a nutrient gelatine infected with the same yeast and of identical composition except that the soluble starch is left out. Of course, no growth occurs in either part, because neither contains any carbohydrate on which this yeast can feed. A small area on A is now strewn with glukase powder and at some distance the same powder is strewn on a part of B. Wherever the glukase powder falls on A, dextrine is formed out of the soluble starch, and from this, under the influence of the same enzym, glucose is produced. The latter is food for the yeast and growth begins at once, but as glucose is not diffusible through the gelatine, and as dextrine is not food, the growth of the yeast is sharply limited to the spot covered by the enzym, which is but slightly diffusible and is itself not food for the yeast. On B there is at first no growth even where the glukase falls, but after a time some of the dextrine produced on A escapes from the enzym spot and, being diffusible, passes through the gelatine without influenceing the imprisoned yeast cells until the glukase spot on B is reached. Here the fresh enzym immediately converts the dextrine into glucose, as shown by the production of an S. ellipsoideus auxanogram, the yeast spot corresponding in shape not to the area strewn with the enzym, but to so much of it as has been entered by the diffusion curve of the dextrine. This method was employed to determine what seeds contain glukase and to locate it in particular parts. The yeast is much more sensitive to minute quantities of glukase than chemical tests or polarized light. Glukase occurs in ungerminated maize principally in the horny part of the endosperm. It also occurs in abundance in the endosperm of sorghum and millet seeds, and is present in the seeds of about a dozen families of monocotyledons, i. e., in those having a mealy endosperm. Most seeds which are free from endosperm, or in which the endosperm is fleshy or horny, do not contain it. It does not occur in ungerminated wheat, rye or barley. Fresh starch grains outside the plant are attacked by glukase just as little as by diastase. Inuline also remains unchanged. The product of the action of glukase on maltose is glucose pure and simple. Dextrine is less readily converted into glucose than is maltose, and soluble starch is still less readily converted. These notes are from the third part of a long paper, Ueber Nachweis und Verbreitung der Glukase, das Enzym der Maltose, in *Centrb. f. Bakt. u. Par., Allg.*, I, 6, 7-8, and 9-10.—ERWIN F. SMITH.

ZOOLOGY.

The Characters of the Enchytræid Genus Distichopus.—In the absence of any information regarding the internal structure of the *Distichopus silvestris* of Leidy, European students of the Oligo-